DOCUMENT RESUME

ED 061 315 TM 001 543

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|---|---|
| TITLE | Insulation-Blanket Maker (aircraft mfg) 809.884 -- Technical Report on Standardization of the General Aptitude Test Battery. |
| INSTITUTION | Manpower Administration (DOL), Washington, D.C. U.S. Training and Employment Service. |
| REPORT NO | TR-S-110 |
| PUB DATE | Sep 57 |
| NOTE | 9p. |
| EDRS PRICE | MF-$0.65 HC-$3.29 |
| DESCRIPTORS | Aerospace Industry; *Aptitude Tests; *Cutting Scores; Evaluation Criteria; Job Applicants; *Job Skills; *Manufacturing Industry; Norms; Occupational Guidance; *Personnel Evaluation; Production Technicians; Test Reliability; Test Validity |
| IDENTIFIERS | GATB; *General Aptitude Test Battery; Insulation Blanket Maker |

ABSTRACT

The United States Training and Employment Service General Aptitude Test Battery (GATB), first published in 1947, has been included in a continuing program of research to validate the tests against success in many different occupations. The GATB consists of 12 tests which measure nine aptitudes: General Learning Ability; Verbal Aptitude; Numerical Aptitude; Spatial Aptitude; Form Perception; Clerical Perception; Motor Coordination; Finger Dexterity; and Manual Dexterity. The aptitude scores are standard scores with 100 as the average for the general working population, and a standard deviation of 20. Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, when combined, predict job performance. Cutting scores are set only for those aptitudes which aid in predicting the performance of the job duties of the experimental sample. The GATB norms described are appropriate only for jobs with content similar to that shown in the job description presented in this report. A description of the validation sample is included. (AG)

ED 061315

PORT

# TECHNICAL REPORT

# ON

# STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY

# FOR

# INSULATION-BLANKET MAKER (aircraft mfg.) ~~7-07-040~~ 809.884

~~B-307~~ S-110

TM 001 543

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U. S. Employment Service
in Cooperation with
the California State Employment Service

U. S. DEPARTMENT OF LABOR
Bureau of Employment Security
Washington 25, D. C.
September 1957

GATB #2137
Summer 1956

# STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY FOR INSULATION-BLANKET MAKER 7-03.040

B-367 S-110

## Summary

The General Aptitude Test Battery, B-1002A, was administered during the period August 9 to August 13, 1956, to 55 Insulation-Blanket Makers 7-03.040 employed by the H. I. Thompson Fiber Glass Company, Inglewood, California. The criterion consisted of broad category supervisory ratings. On the basis of mean scores, correlations with the criterion, job analysis data and their combined selective efficiency, Aptitudes P-Form Perception, F-Finger Dexterity and M-Manual Dexterity were selected for inclusion in the test norms.

## GATB Norms for Insulation-Blanket Maker 7-03.040 - B-367

Table I shows, for B-1001 and B-1002, the minimum acceptable score for each aptitude included in the test norms for Insulation Blanket Maker 7-03.040.

TABLE I

Minimum Acceptable Scores on B-1001 and B-1002 for B-367

| B-1001 | | | B-1002 | | |
|---|---|---|---|---|---|
| Aptitude | Tests | Minimum Acceptable Aptitude Score | Aptitude | Tests | Minimum Acceptable Aptitude Score |
| P | CB-1-A<br>CB-1-L | 75 | P | Part 5<br>Part 7 | 75 |
| F | CB-1-O<br>CB-1-P | 80 | F | Part 11<br>Part 12 | 75 |
| M | CB-1-M<br>CB-1-N | 90 | M | Part 9<br>Part 10 | 85 |

## Effectiveness of Norms

The data in Table IV indicate that 7 of the 13 poor workers, or 54 percent of them, did not achieve the minimum scores established as cutting scores on the recommended test norms. This shows that 54 percent of the poor workers would not have been hired if the recommended test norms had been used in the selection process. Moreover, 34 of the 40 workers who made qualifying test scores, or 85 percent, were good workers.

TECHNICAL REPORT

## I. Problem

This study was conducted to determine the best combination of aptitudes and minimum scores to be used as norms on the General Aptitude Test Battery for the occupation of Insulation-Blanket Maker 7-03.040.

## II. Sample

The GATB, B-1002A, was administered during the period August 9 to August 13, 1956 to a total sample of 56 workers (51 women and 5 men) employed as Insulation-Blanket Maker 7-03.040 in the Hi-Temperature Department of the H. I. Thompson Company, Inglewood, California. This number represented approximately 75 percent of the plant population employed as Insulation-Blanket Makers (12 men and 63 women). All of the workers in the sample had completed the necessary six-week training period. One female worker was excluded from the final sample because of her extreme nervousness during the testing period. Therefore, the final sample includes 55 workers (50 women and 5 men).

Workers are selected on the basis of a personal interview and are usually referred by the State Employment Service. The company prefers applicants between the ages of 20 and 35, with 9 or 10 years of education and with one year of experience in a production shop. However, applicants between the ages of 20 and 45, with 7 or 8 years of education and no experience are accepted.

Table II shows the means, standard deviations, ranges, and Pearson product-moment correlations (corrected for broad categories) with the criterion for age, education, and experience.

TABLE II

Means (M), Standard Deviations ($\sigma$), Ranges, and Pearson Product-Moment Correlations (Corrected for Broad Categories) with the Criterion ($_{c}r$) for Age, Education, and Experience

Insulation-Blanket Maker 7-03.040
N = 55

| | M | $\sigma$ | Range | $_{c}r$ |
|---|---|---|---|---|
| Age (years) | 37.0 | 8.9 | 20-59 | .320* |
| Education (years) | 10.1 | 1.8 | 7-15 | -.214 |
| Experience (months) | 26.7 | 20.1 | 6-65 | .636** |

** Significant at the .01 level
* Significant at the .05 level

The data in Table II indicate that there is no significant correlation between education and the criterion. The correlation between age and the criterion is significant at the .05 level, which may indicate that the older workers tend to be more productive or it may indicate a bias on the part of supervisors in favor of the older workers. The correlation between experience and the criterion is significant at the .01 level. The company officials estimated that six weeks of training time was needed to reach normal production. All of the workers in the sample had at least six months of experience. The personnel manager stated that because some tasks of the work performed are monotonous, workers are transferred from one task to another about every six months and that because of the large variety of tasks, the learning period may still be operative from the sixth month to the twenty-fourth month. Thus, the significant correlation between experience and the criterion may reflect a true relationship between job proficiency and the length of time on the various tasks. Since the criterion consists of subjective ratings, it was not feasible to correct the criterion statistically to nullify the influence of experience. The data in Table II indicate that the sample is suitable for test development purposes with respect to age, education and experience.

## III. Job Description

Job Title: Insulation-Blanket Maker 7-03.040

Job Summary: Fabricates heat-insulation blankets for aircraft jet engines by cutting, crimping, punching, and spot-welding sheet metal and other materials. Operates an Electric Cutting Machine to cut excess material from stainless steel sheet metal blanket or jacket parts. Operates Hand Punch Press to punch out pre-located holes for eyelets or hooks. Operates Grommet Machine to insert eyelets, ventilating eyelets, and/or hooks in pre-punched holes. Operates Spot-Welding Machine to weld metal ventilating cover over ventilating eyelets and to inspect and patch holes in blanket or jacket parts. Assembles blanket or jacket parts, fiber glass and aluminum foil insulation units, and tack welds them together. Seam welds large parts, or spot welds small parts around edge of pre-tacked welded units.

Work Performed: Performs one or more of the operations described to fabricate heat-insulation blankets and jackets for Jet Aircraft Engines.

Operates an Electric Cutting Machine to cut excess material from stainless steel sheet metal blanket or jacket parts: Starts machine, and guides part with both hands between two revolving circular cutting knives, co-ordinating movements with speed of machine. Cuts off excess material around pre-formed guide lines, leaving enough material to be trimmed and crimped during the finishing operation.

Operates Hand Punch Press to punch out pre-located holes for eyelets or hooks: Places part in machine and alines hole mark under punch. Steadies part with one hand, and pulls lever with other to force punch through metal and cut hole. Repeats process on all other holes to be punched. Trims off any material not cleanly cut free by punch press with Hand Cutters.

Operates Grommet Machine to insert eyelets, ventilating eyelets, and/or hooks in pre-punched holes: Places bottom section of eyelet or hook in bed of machine, inserts blanket or jacket part over bed of machine until proper hole is alined under ram of machine. Inserts washer and top section of eyelet or hook over bottom section, depresses treadle to rivet both sections together, and to crimp them to the metal. Repeats process on all other holes.

Operates Spot-Welding Machine to weld metal ventilating cover over ventilating eyelets: Places blanket or jacket part between welding rods of machine and positions metal cover over ventilating eyelet. Alines parts under welding rod, depresses treadle to bring electrodes together with metal pieces to be joined between them, thus instantly welding them together. Spot welds ventilating cover on three sides, leaving bottom side open for ventilation. Repeats process on all ventilating eyelets.

Assembles blanket or jacket parts, fiber glass and aluminum foil insulation units, and tack welds them together: Inserts bottom form of blanket or jacket in Die Holder, and fits form to die by hand and with rubber mallet, so that it conforms to die. Selects pre-cut fiber glass and foil insulation unit, according to job specification, from supply table, and positions them into depression of part in die. Trims off excess insulation material with Hand Cutters. Places top form of blanket or jacket over the insulation material, alines it with bottom form, poking the insulation into place with small flat hand tool, and brings the two edges together. Places metal weights around edge to hold both parts in position. Tack welds both blanket or jacket parts together with two hand Tack Welding Guns (positive and negative). Positions negative electrode on spot to be welded, and touches positive electrode to metal, adjacent to negative electrode, exercising care that touch is not too heavy, otherwise material will burn; or too light, which will cause electrodes to arc and burn holes in material. Repeats process, allowing enough time between tacks for machine to build current back up, until the two blanket or jacket parts are tack welded together around edge. Removes the metal weights as the welding progresses.

Seam welds large parts, or spot welds small parts (about 50-50), around edge of pre-tacked welded units, following guide lines:

1. Seam-Welding: Starts machine and guides part between two revolving circular welding disks, co-ordinating movements with speed of machine, and welds an air tight seam around edge of part, following pre-formed outline.

2. Spot-Welding: Starts machine and positions part between welding rods of machine. Depresses treadle to bring electrodes together with the metal, thus instantly welding the parts together. Repeats process following outline of part, until an air tight seal is welded around outside edge.

Inspects for size and prepares holes by performing one or the other of the following tasks:

1. Inspects with Master Die: Places assembled part on Master Die, and with rubber mallet, pounds around edge of part so that it conforms to die, and rejects those that do not meet specifications. Marks accepted part for additional holes to be punched as indicated on Master Die, with a wax pencil. Operates a Hand Punch Press to punch out pre-marked holes.

2. Inspects with Master Pattern: Alines master metal pattern on part and attaches small "C" clamps to hold in place. Rejects those that do not conform to pattern. Drills out holes as indicated in pattern with small Hand Drill, removes clamps, and repeats process on next part.

Operates Grommet Machine to insert eyelets or hooks in the pre-punched holes.

Oporates an Electric Cutting Machine to trim part of 1/4" of finished edge.

Cuts out slots or indentations as marked on part to tolerance of 1/16" with Hand Cutters, and snips slits in corners and where necessary along curve, so that material when folded back, will fold flat.

Crimps edge with Hand Crimper Machine or by hand:

1. Machine Crimping: Inserts part between rollers, guides part with one hand and turns crank with other hand, to fold edge back 1/4" and crimp edge of part flat.

2. Hand Crimping: Folds edge back 1/4" and crimps edge flat with pliers.

Seam welds large parts, or spot welds small parts with an air tight seam around crimped edge of part to produce a finished unit.

Inspects and patches holes in blanket or jacket parts, by operating a Spot-Welding Machine: Visually inspects parts for small burnt holes caused during the welding process. Patches holes by cutting out small patches from sheet stock of the same material part is made from with Hand Cutters, and spot welds a patch over each hole so that it is air tight. Repeats process on next part.

IV. Experimental Battery

All of the tests of the GATB, B-1002A, were administered to the sample group.

V. Criterion

The criterion consisted of supervisory ratings in broad categories, prepared by the first line supervisors. The first line supervisors placed 3 x 5 cards containing the names of workers under their supervision in one of three categories, "above average," "average" or "below average." An attempt was made to force the sample into thirds, but because of a recent layoff in which

workers in the "below average" group had been discharged, there was no agreement among the raters with respect to which remaining workers to shift from one category to another. The final grouping resulted in 20 workers being placed in the "above average" group, 22 workers in the "average" group and 13 workers in the "below average" group. For computational purposes the qualitative ratings were converted to quantitative scores of 60, 48 and 37 for the above average, average and below average groups, respectively.

Rank order ratings were also obtained by having second line supervisors (the production foreman and the production superintendent) select the highest and lowest third with respect to job performance. (The remainder was the middle third.) Workers were then ranked within each of the three groups and differences were resolved by discussion. For statistical analysis, the rank order ratings were converted to linear scores.

The product-moment correlation (corrected for one variable expressed in broad categories) between the first line supervisors' ratings and the second line supervisors' ratings was .86, indicating good agreement between the two sets of ratings. However, the first line supervisors' ratings were used for validation purposes because it was believed that they were in a better position to rate their workers on quantity and quality factors.

## VI. Statistical and Qualitative Analysis

Table III shows the means, standard deviations, and Pearson product-moment correlations (corrected for broad categories) with the criterion for the aptitudes of the GATB. The means and standard deviations of the aptitudes are comparable to general working population norms with a mean of 100 and a standard deviation of 20.

TABLE III

Means (M), Standard Deviations ($\sigma$), and Pearson Product-Moment Correlations (Corrected for Broad Categories) with the Criterion ($_{c}r$) for the Aptitudes of the GATB

Insulation-Blanket Maker 7-03.040
N = 55

| Aptitude | M | $\sigma$ | $_{c}r$ |
|---|---|---|---|
| G-Intelligence | 91.6 | 15.6 | -.102 |
| V-Verbal Aptitude | 95.5 | 17.0 | -.100 |
| N-Numerical Aptitude | 89.9 | 16.4 | .123 |
| S-Spatial Aptitude | 90.4 | 16.1 | -.134 |
| P-Form Perception | 92.1 | 17.4 | .112 |
| Q-Clerical Perception | 98.5 | 13.7 | .111 |
| K-Motor Coordination | 99.7 | 16.4 | -.010 |
| F-Finger Dexterity | 101.5 | 19.3 | .124 |
| M-Manual Dexterity | 106.8 | 19.7 | .168 |

The statistical results were interpreted in the light of the job analysis data. The job analysis indicated that the following aptitudes measured by the GATB appear to be important for this occupation:

Form Perception (P) - required for selecting parts, cutting proper shapes preparatory to crimping, welding finished edge and in detecting and correcting flaws in the finished assembled part.

Motor Coordination (K) and Finger Dexterity (F) - required in coordinating hand and finger movements with speed of the machine and in using fingers to pick up and position small hooks, eyelets and washers in the assembly operation.

Manual Dexterity (M) - required in positioning and guiding parts in machines, and in such tasks as bending, pounding, and turning of parts.

The highest mean scores in decreasing order of magnitude were obtained for Aptitudes M, F, K and Q, respectively. Aptitude Q exhibits the smallest standard deviation. None of the aptitudes show significant correlations with the criterion.

Aptitudes P, K, F and M were considered for inclusion in the test norms on the basis of the quantitative and qualitative factors cited above. All of these aptitudes appear to be important in terms of the job analysis data; in addition, Aptitudes K, F and M have the highest mean scores for this sample. Although Aptitude Q had a relatively high mean score and exhibited the smallest standard deviation, it did not appear to be important on the basis of the job analysis data, and, therefore, was not given further consideration for inclusion in the test norms.

Several sets of norms, consisting of various combinations of Aptitudes P, K, F and M with appropriate cutting scores were selected for tryout. The relationship between each of these sets of trial norms and the dichotomized criterion was determined by means of the tetrachoric correlation technique. A comparison of the results showed that norms consisting of P-75, F-75 and M-85 had better selective efficiency than any other set of norms tried. The cutting scores for Aptitudes P, F and M are each within 10 points of one standard deviation below the sample mean.

## VII. Concurrent Validity of Norms

For the purpose of computing the tetrachoric correlation coefficient between the test norms and the criterion and applying the Chi Square test, the criterion was dichotomized by placing those workers who were rated "above average" and "average" into the high criterion group and those workers who were rated "below average" into the low criterion group. This placed 13 of the 55 workers, or 24 percent of them, into the low criterion group.

Table IV shows the relationship between the test norms consisting of Aptitudes P, F and M with critical scores of 75, 75 and 85, respectively, and the dichotomized criterion. Workers in the high criterion group have been designated as "good workers" and those in the low criterion group as "poor workers."

TABLE IV

Relationship between Test Norms Consisting of Aptitudes P, F and M with Critical Scores of 75, 75 and 85, Respectively, and the the Criterion for Insulation-Blanket Maker 7-03.040

N = 55

| | Non-Qualifying Test Scores | Qualifying Test Scores | Total |
|---|---|---|---|
| Good Workers | 8 | 34 | 42 |
| Poor Workers | 7 | 6 | 13 |
| Total | 15 | 40 | 55 |

$r_{tet} = .56$ $\quad X^2 = 4.433$

$\sigma_{r_{tet}} = .25$ $\quad P/2 < .025$

The data in the above table indicate a significant relationship between the test norms and the criterion for this sample.

## VIII. Conclusions

On the basis of mean scores, correlations with the criterion, job analysis data and their combined selective officiency, Aptitudes P, F and M with minimum scores of 75, 75 and 85, respectively, are recommended as B-1002 norms for the occupation of Insulation-Blanket Maker 7-03.040. The equivalent B-1001 norms consist of P-75, F-80 and M-90.

## IX. Determination of Occupational Aptitude Pattern

When the specific test norms for an occupation include three aptitudes, only those occupational aptitude patterns which include the same three aptitudes with cutting scores that are within 10 points of the cutting scores established for the specific norms are considered for that occupation. The only one of the existing 22 occupational aptitude patterns which meets these criteria for this study is OAP-16, which consists of P-75, F-80 and M-80 for B-1002. The selective efficiency of OAP-16 for this sample was determined by means of the tetrachoric correlation technique. No significant relationship was obtained between OAP-16 and the criterion for this experimental sample. Therefore, none of the existing 22 occupational aptitude patterns is recommended for Insulation-Blanket Maker 7-03.040. However, the data for this sample will be considered for future groupings of occupations in the development of new occupational aptitude patterns.